

Challenges for LIDAR Space Missions

Prof Iain H Woodhouse

<http://forestplanet.wordpress.com>

@fortiain

With thanks to:

Caroline Nichol, Genevieve Patenaude, Andy Wallace, Gerald Buller,
John Moncrieff, Jim Jack, Emal Rumi, David Henry, Mal MacDonald

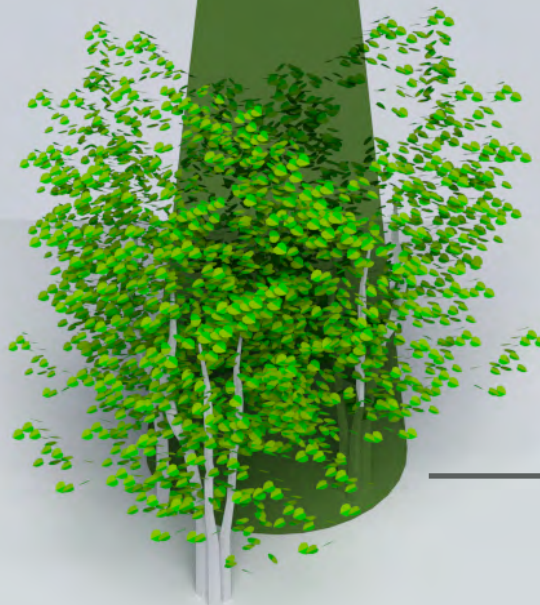
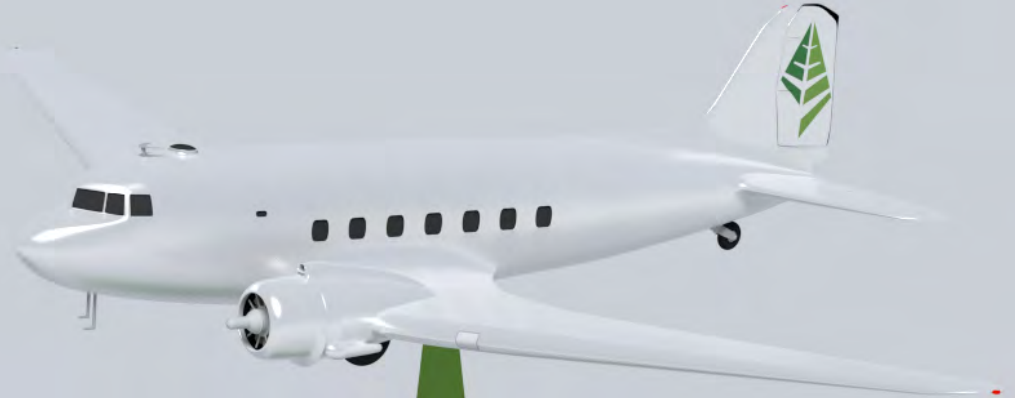


OUTLINE

- Background - why LiDAR in space?
- Full waveform vs photon counting
- Experiments and models
- Concept for a space mission
- Where we are

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*ALADIN on ADM-
Aeolus*

Source: diode-
pumped Nd:YAG
400mJ, 100ns,
1064nm, 100Hz

1.5m primary

(will be) mature,
space based,
efficient pulse
emission for 532nm

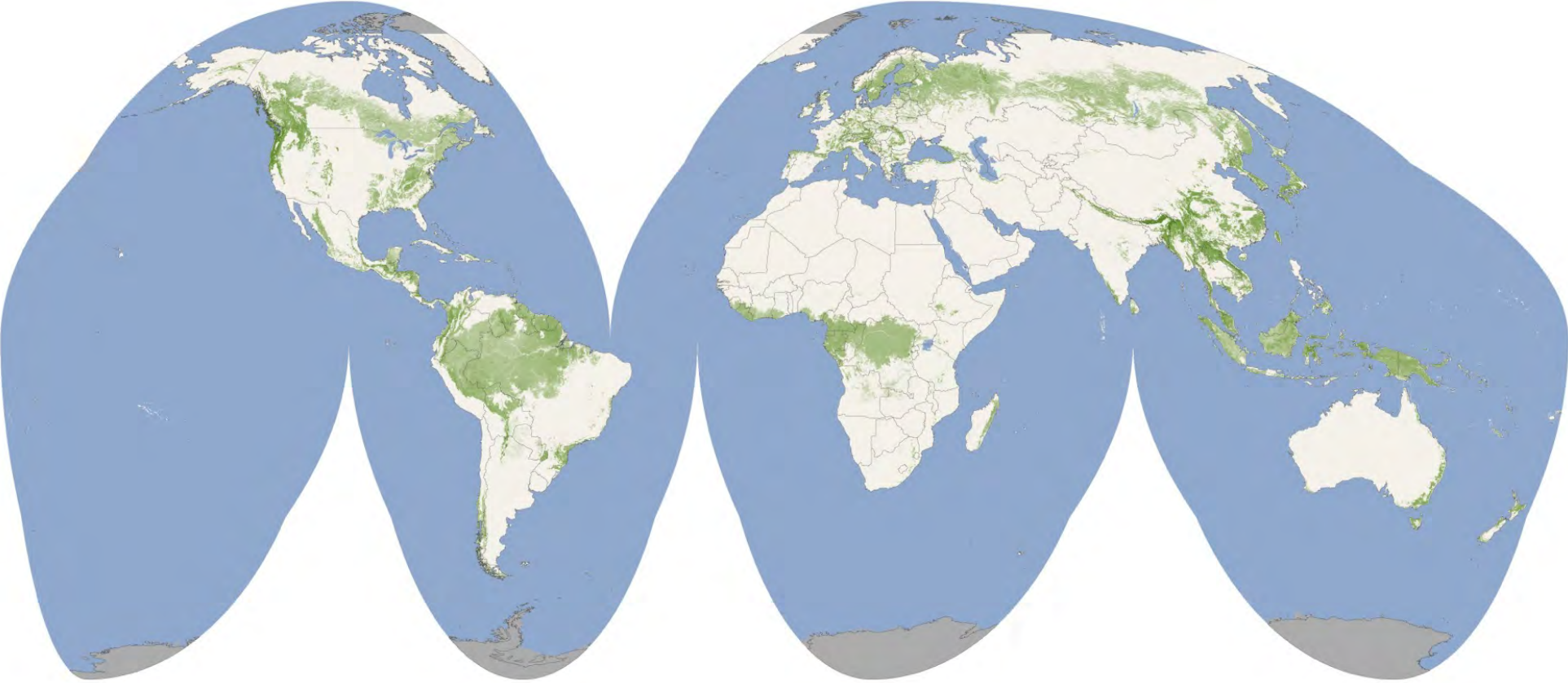
Launch: July 2015



Courtesy of Nick Hughes, SAMS



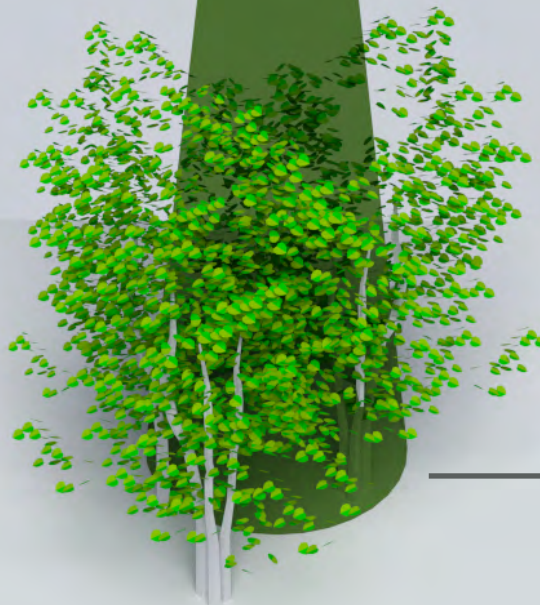
Global canopy height (from GLAS and others)



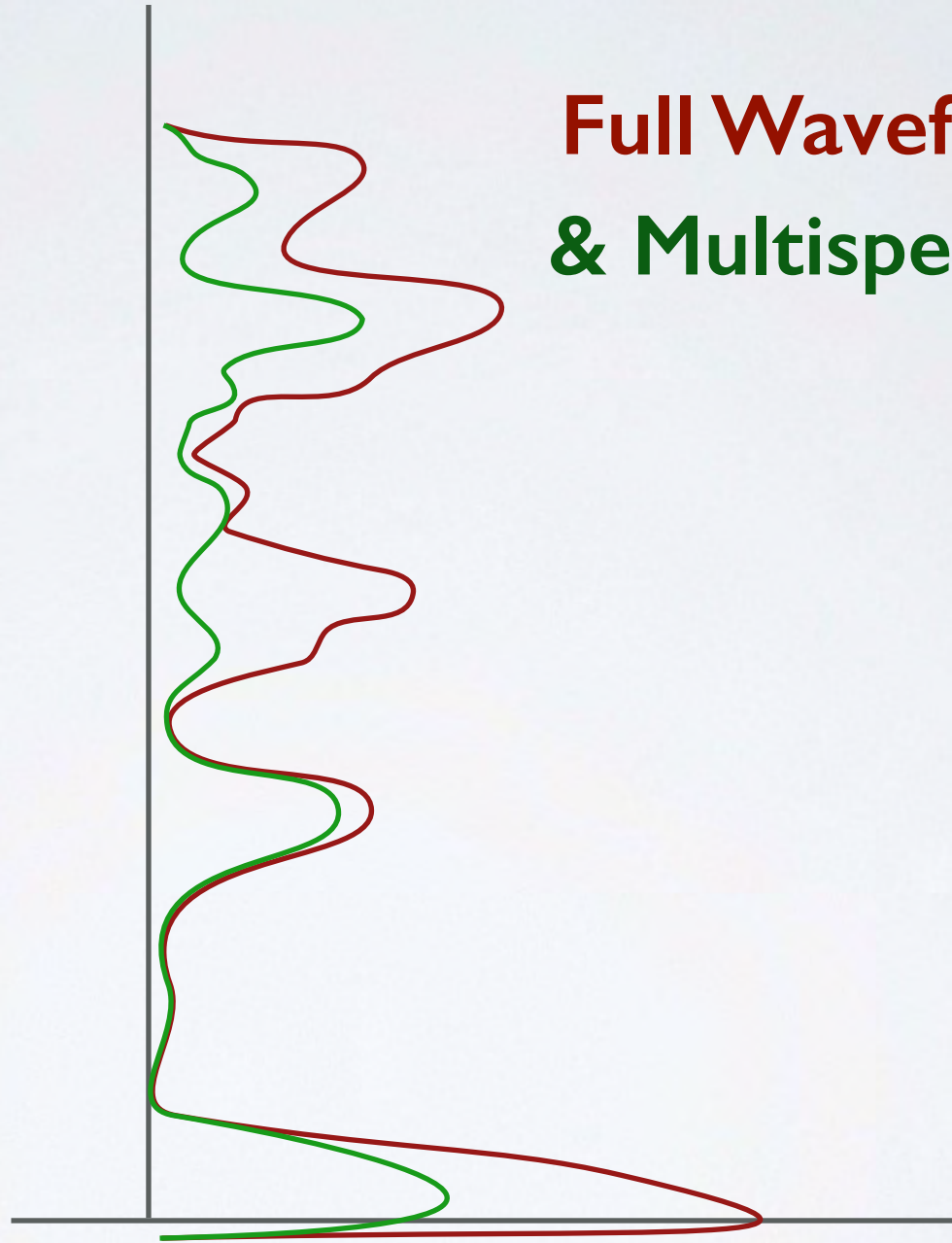
Lefsky et al, 2010

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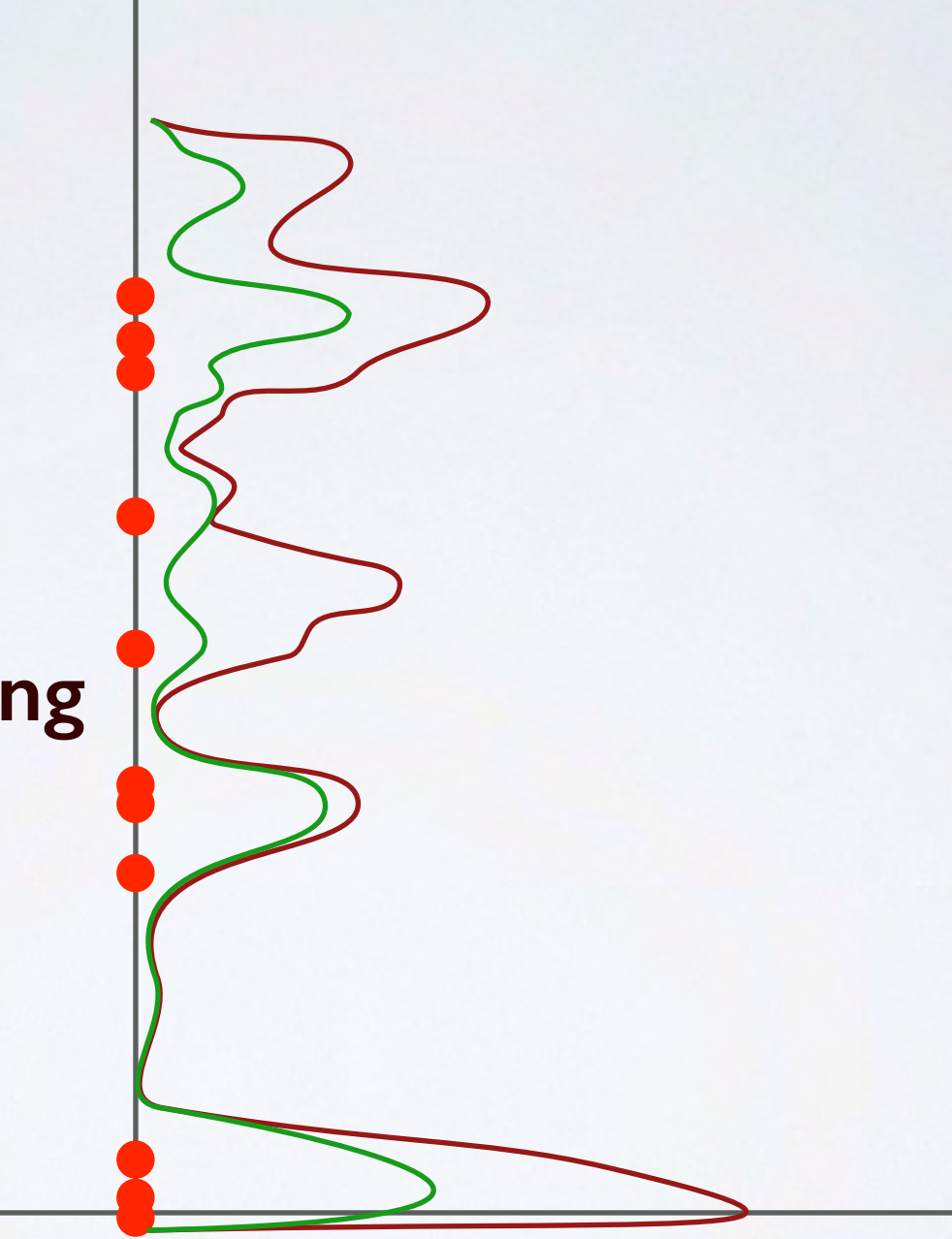
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Full Waveform & Multispectral



Photon Counting



Multi-spectral or photon counting?

Multispectral

Full waveform

High ν resolution

High h resolution

Spectral information

Narrow coverage

Expensive (air and space)

Technically challenging

Photon counting

Individual photons

Can achieve high ν resolution if...

...Low h resolution

No spectral or brightness information

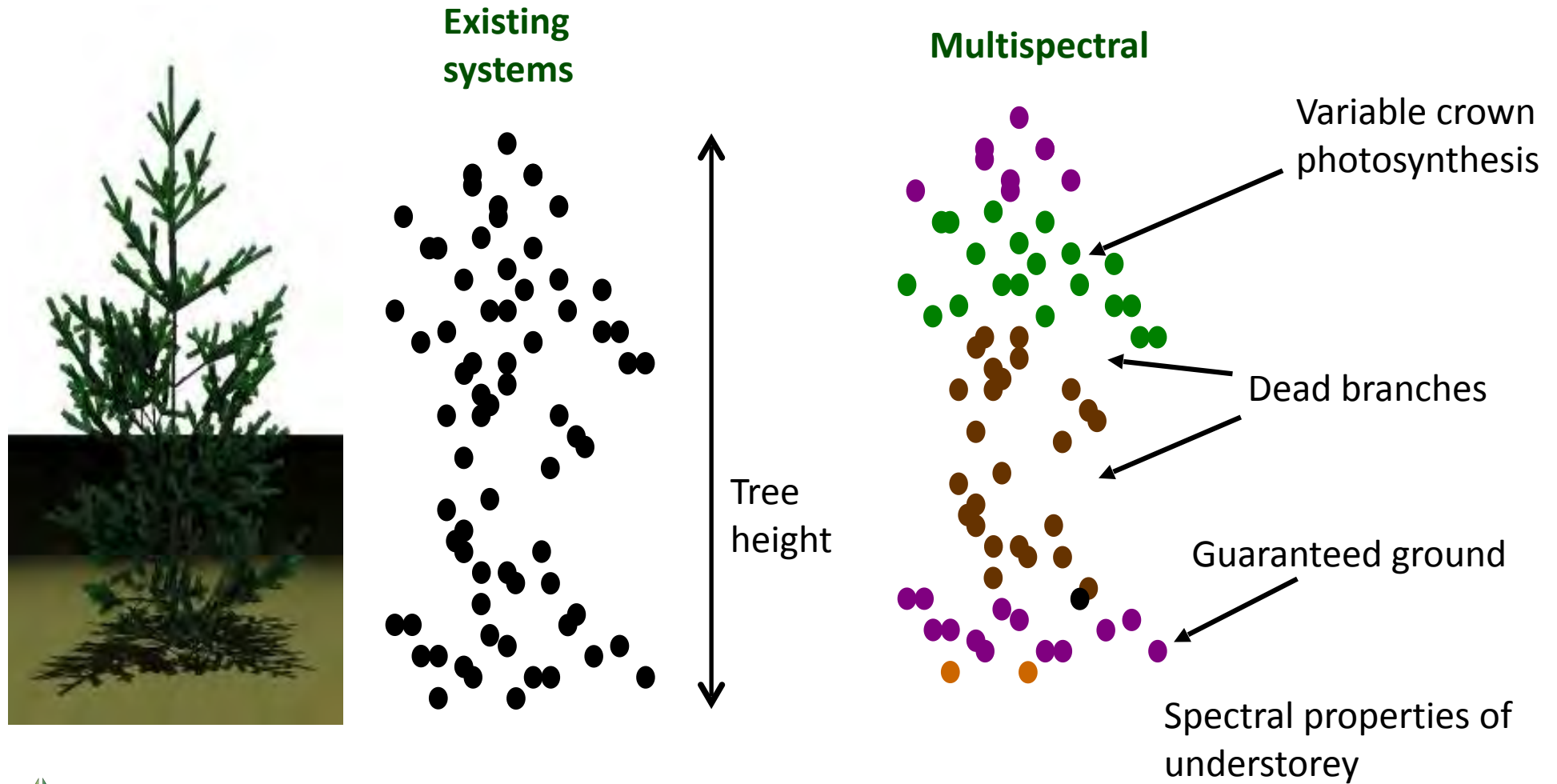
Wide coverage

Inexpensive (air and space)

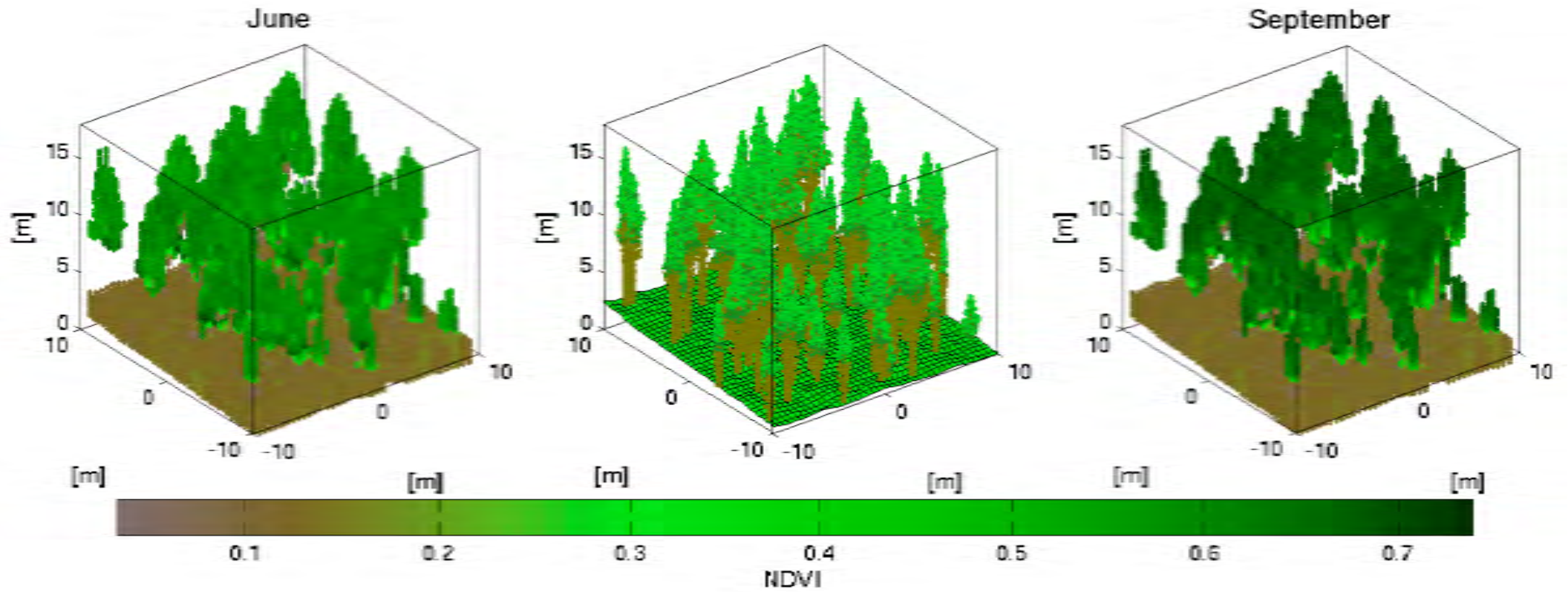
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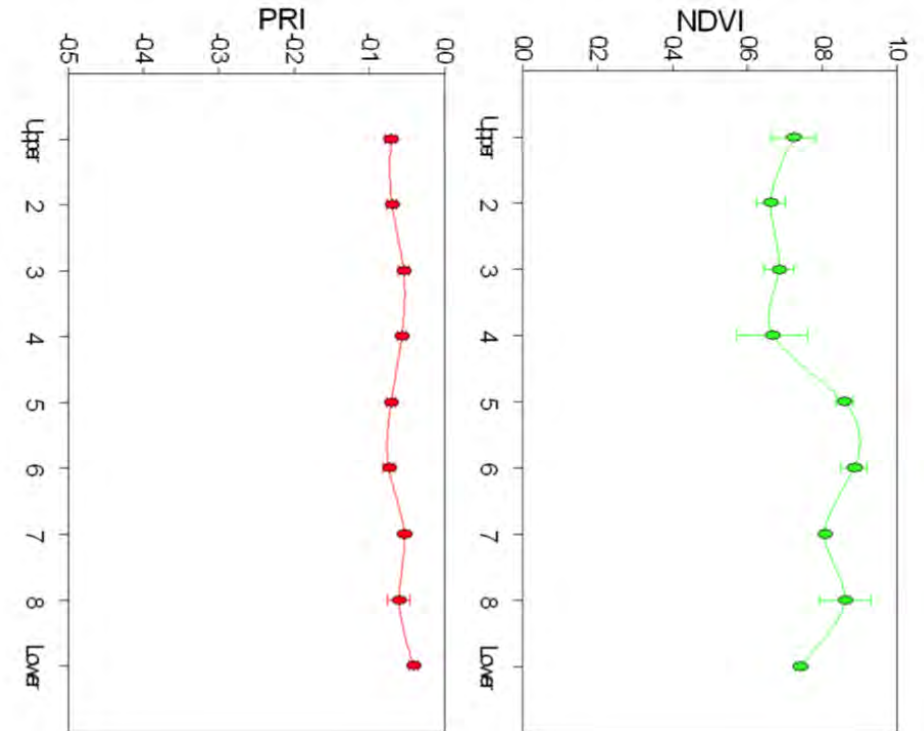
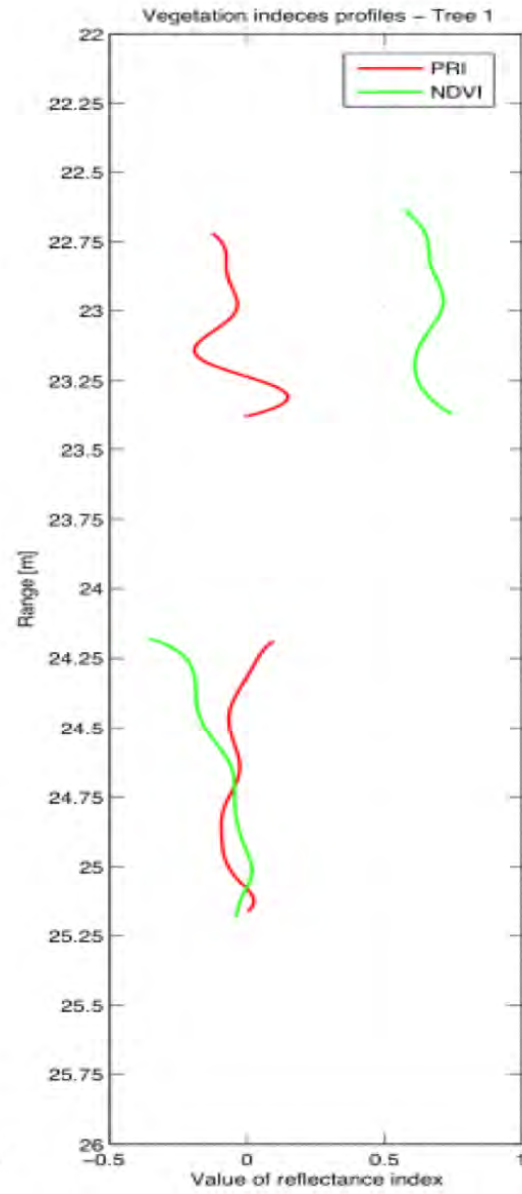
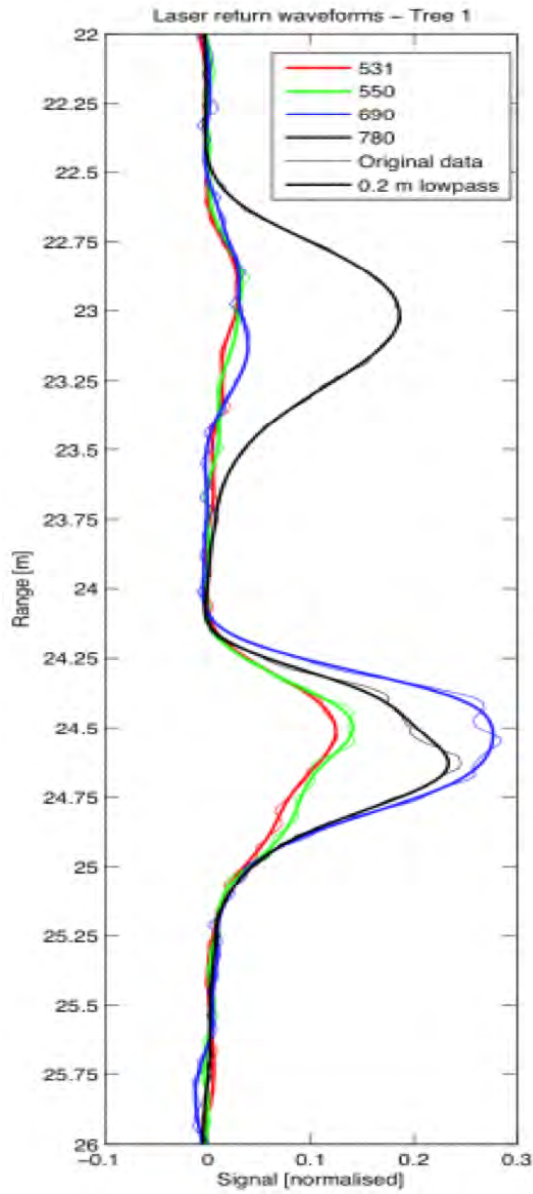
Multispectral lidar



Modelled seasonal responses



Woodhouse et al, GRSL, 2011



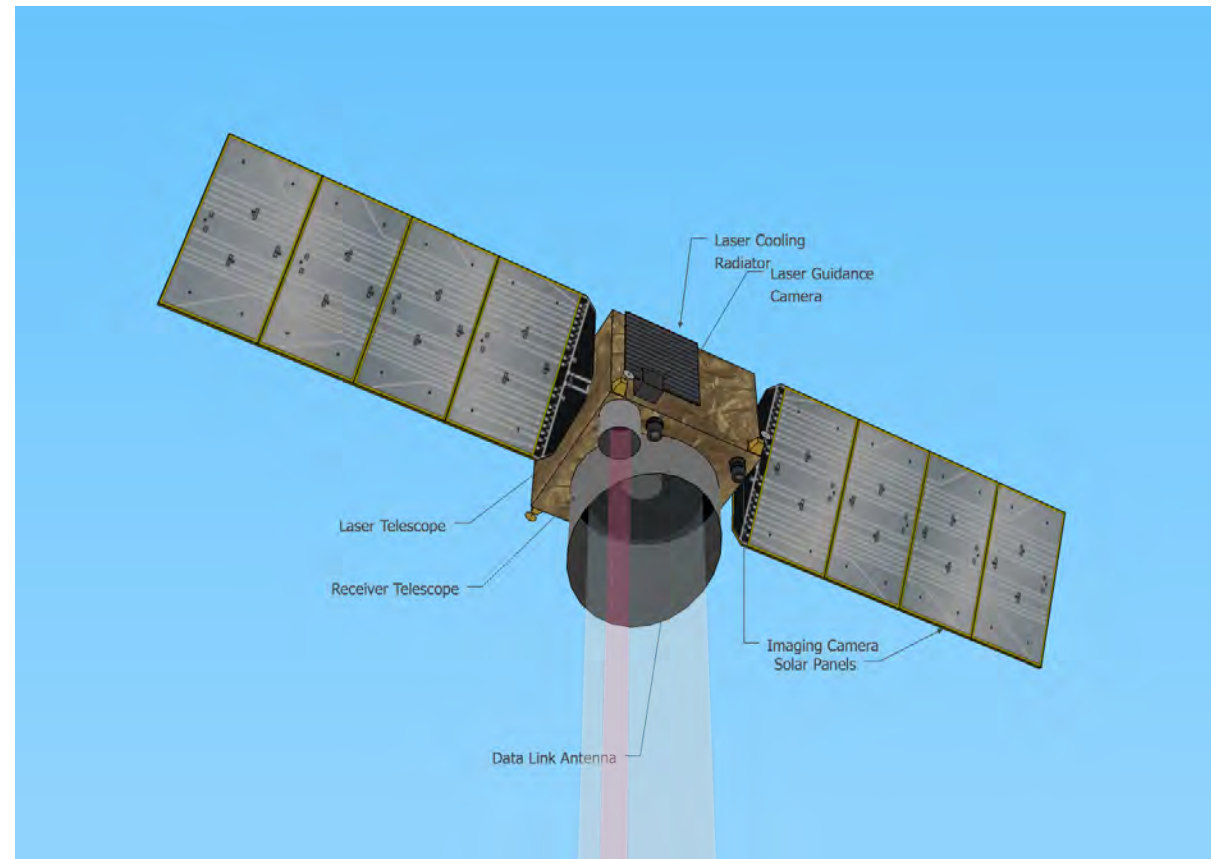
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TYPICAL SPACEBORNE LIDAR FOR LAND SURFACE

- Large footprint (>>metres)
 - Beam divergence
 - Eye safety
- Non-scanning (so far)
 - Sparse footprint grid
 - PRF vs power
- Large mirror (>1m)
 - Energy is a premium (But... photon counting?)

Spaceborne Multi-Spectral Canopy LiDAR “SpeCL”



The SpeCL mission

- Large footprint (30m) waveform lidar
- 1 km grid sampling
- Revisit same footprint every 90 days
- 4 wavelengths (actually, 6!)
 - PRI: 532nm (44mJ) and 570nm (44mJ)
 - NDVI: 660nm (70mJ) and 780nm (27mJ)
 - Additional: 1320nm and 1569nm
- Vertical structure and information on processes

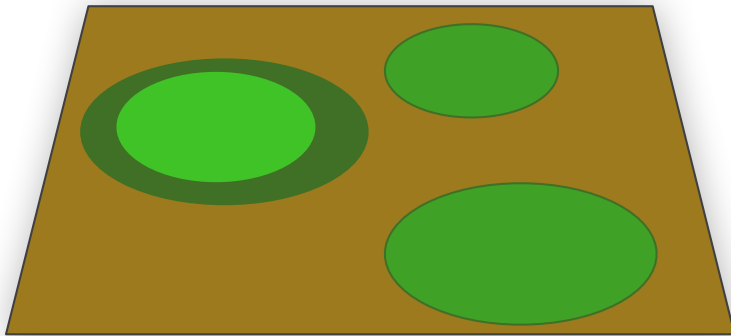
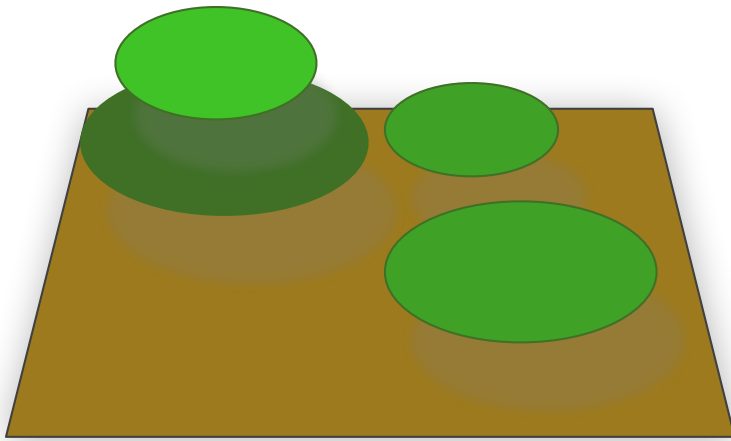
SpeCL: A multiSpectral Canopy Lidar



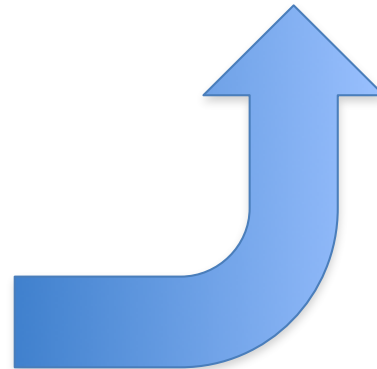
- proposal was submitted to ESA Earth Explorer – EE8 call, June, 2010
- *“a very innovative mission concept, but at present it is technically very immature.”*
- *“ESAC recommends that studies be conducted ..*
“(1) to develop and demonstrate the observation technique, supported by airborne campaigns with a prototype instrument; “

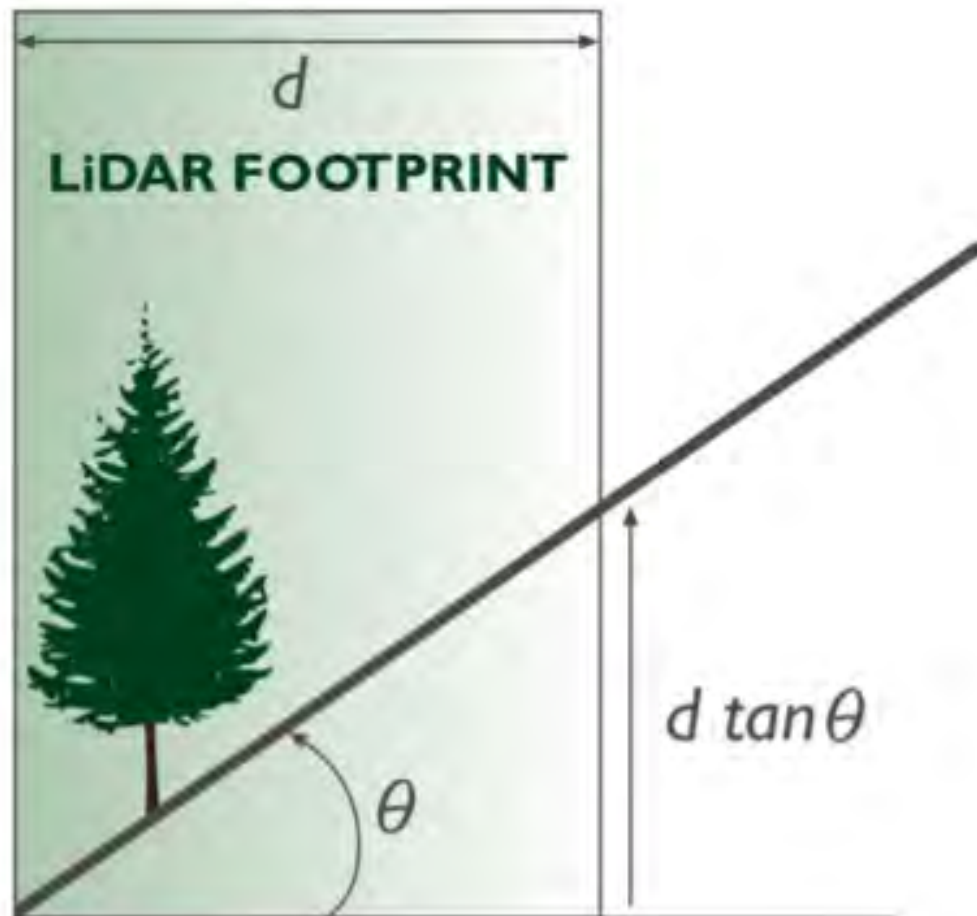
Mixed pixel calibration

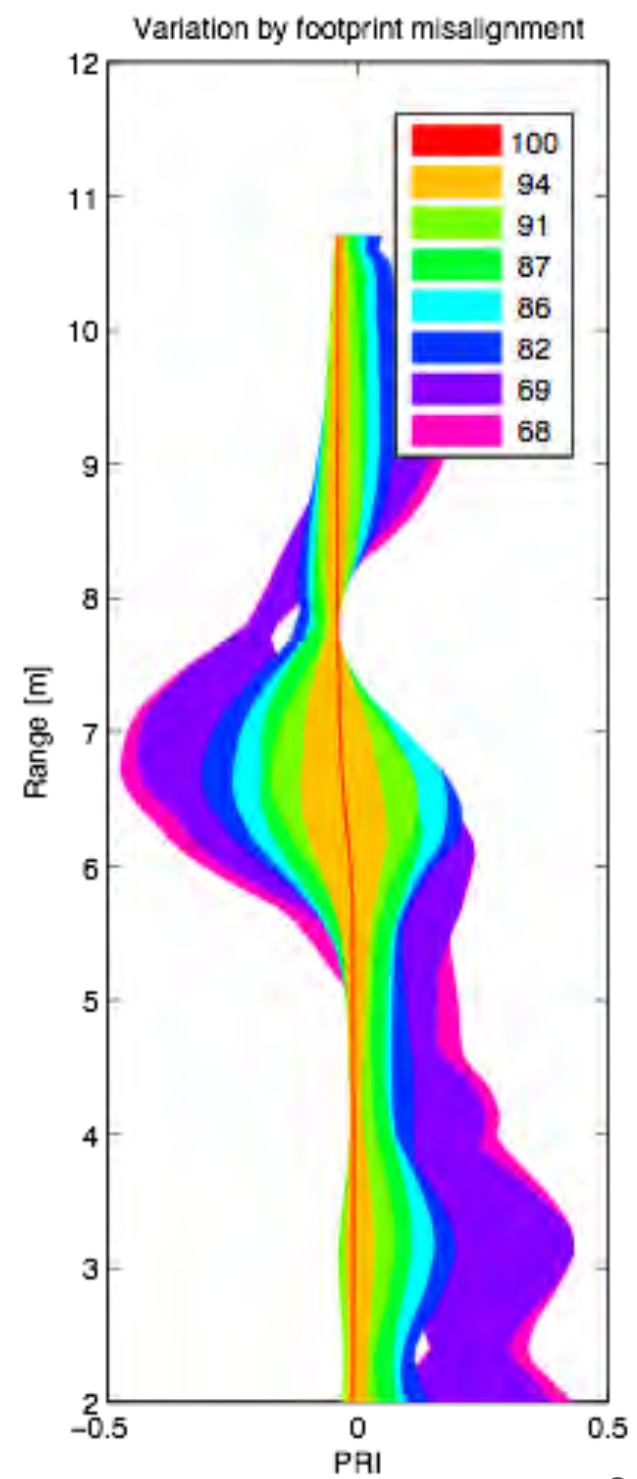
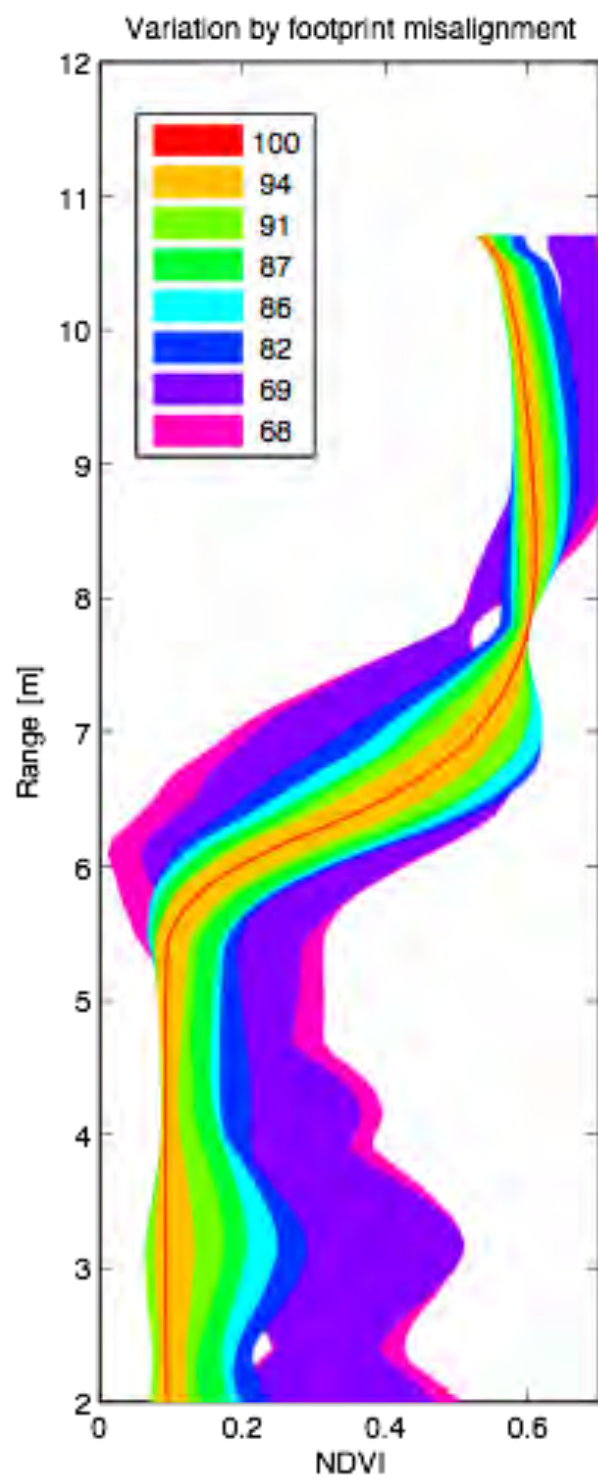
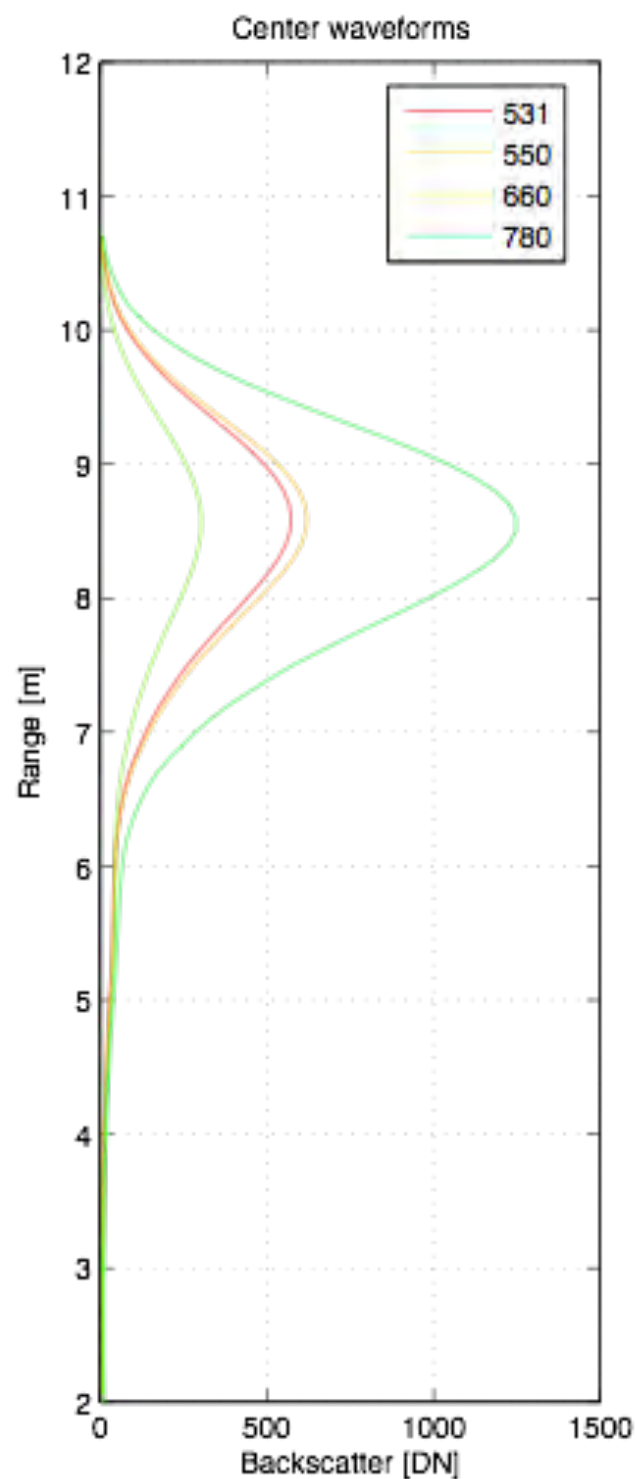
Multispectral lidar footprint



Multispectral "mixed" pixel





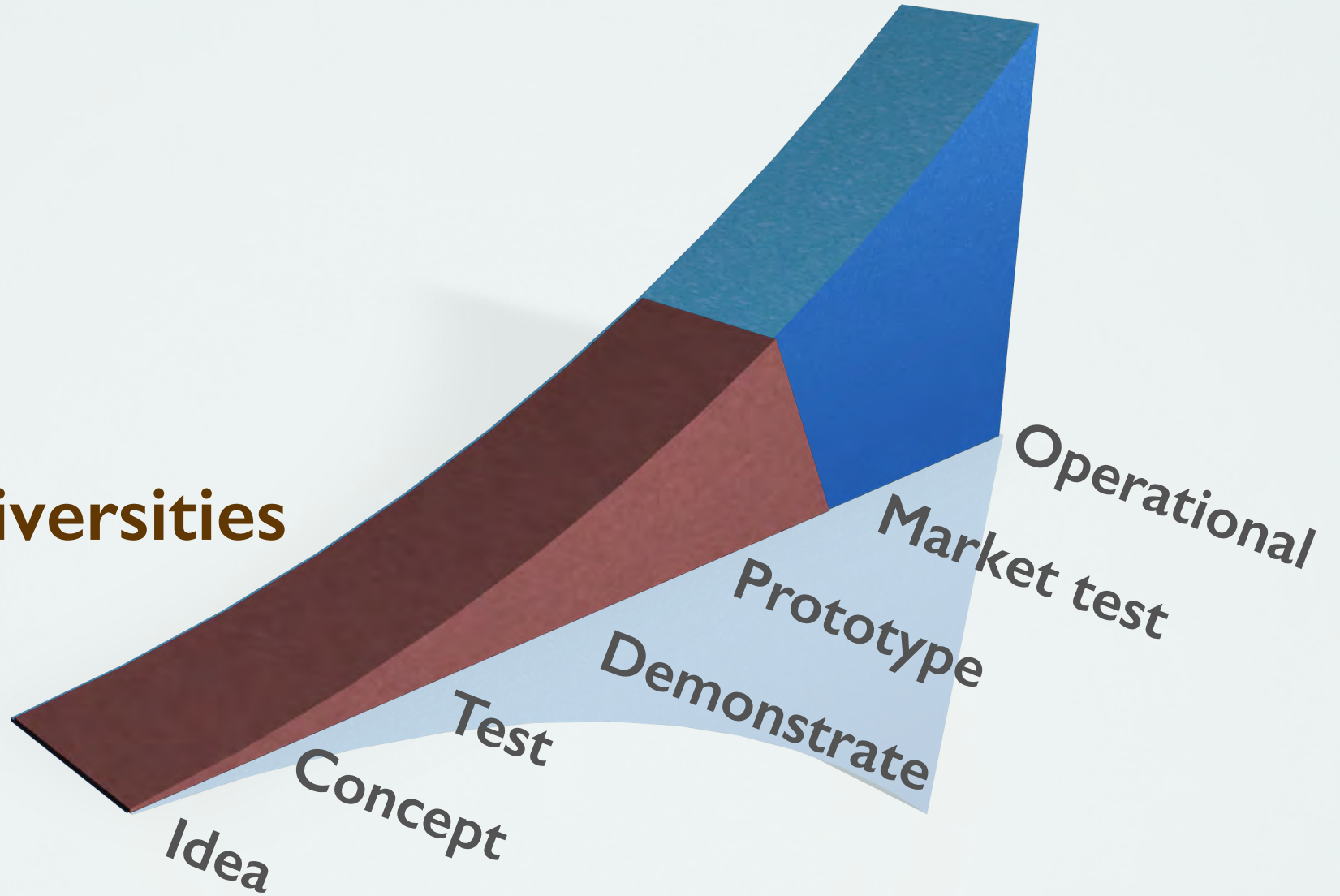


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Commercial

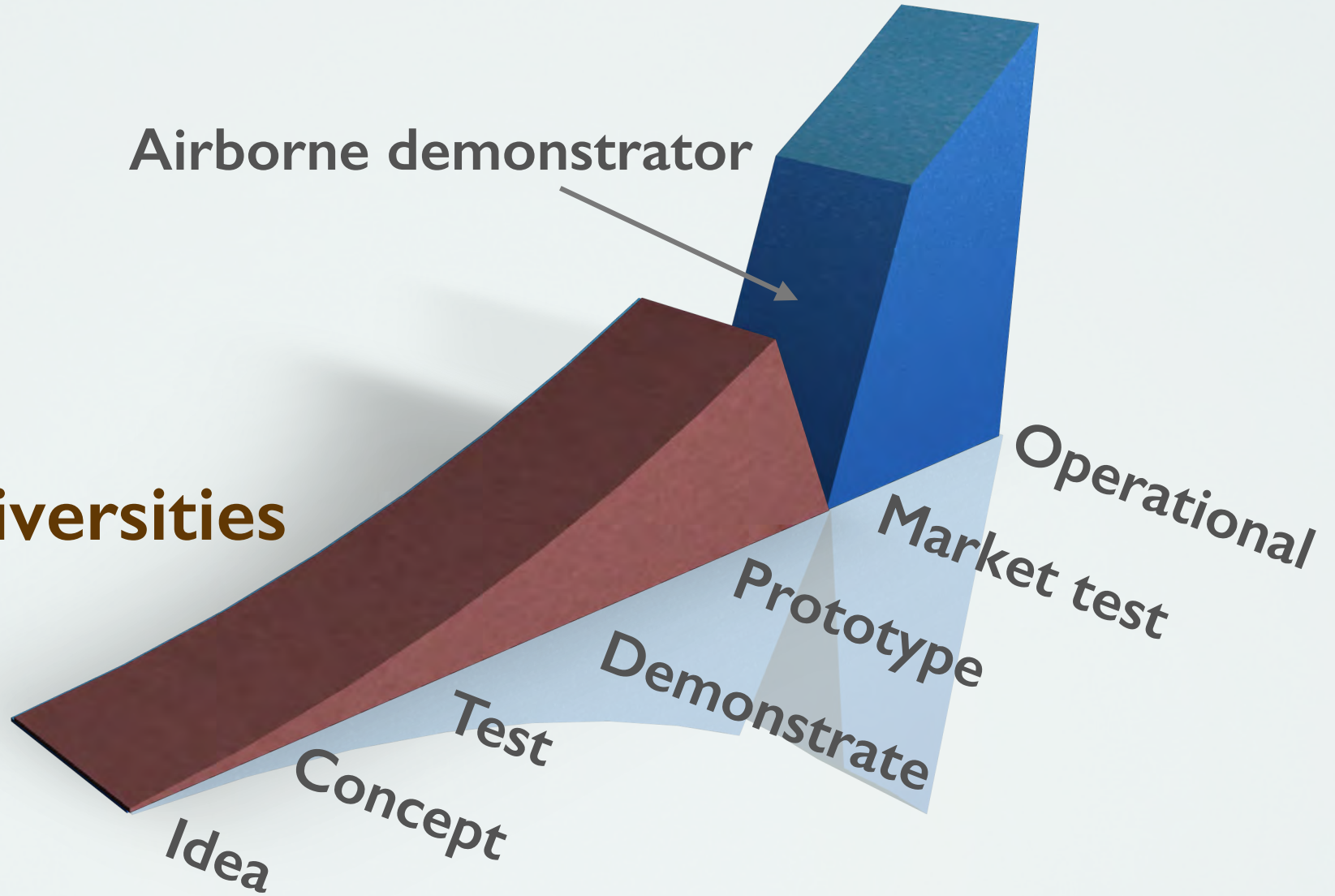
Universities



Commercial

Airborne demonstrator

Universities



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